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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/681,611	05/08/2001	Gopal B. Avinash	15-XZ-5728	8599

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EXAMINER	
PATEL, SHEFALI D	

ART UNIT	PAPER NUMBER
2621	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/681,611	AVINASH ET AL.	
	Examiner	Art Unit	
	Shefali D Patel	2621	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 May 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20 and 26-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *21-25* is/are allowed.

6)☒ Claim(s) *1,6,7,13,18-20 and 26-29* is/are rejected.

7)☒ Claim(s) *2-5,8-12 and 14-17* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 May 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 2.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to because the box elements in Figure 1 (elements 102, 120, 116, 122, 112) need to be labeled in accordance with 37 C.F.R. § 1.83(a) as stated infra. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specifically, 37 C.F.R. § 1.83(a) states that "the drawing in a nonprovisional application must show every feature of the invention specified in the claims. However, conventional features disclosed in the description and claims, where their detailed illustration is not essential for a proper understanding of the invention, should be illustrated in the drawing in the form of a graphical drawing symbol or a labeled representation (e.g., a labeled rectangular box)."

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 6, 13, 18-20, and 26-28 are rejected under 35 U.S.C. 102(b) as being anticipated by Shimura (US 5,301,107).

With regard to **claim 1** Shimura discloses a method for automatically determining structure cancelled image in a dual energy decomposition system (Fig. 6, col. 19 lines 3-24), the method comprising: obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure (obtaining a high energy level image of at least a bone and a tissue at 7A, Fig. 1, col. 11 lines 25-26); obtaining a second low energy level image of the internal anatomy formed of at least first and second types of structure at an energy level lower than the first energy level image (obtaining a low energy level image at 5A, Fig. 1, col. 11 lines 23-24); computing a characteristic mask using the low energy level image (the characteristic masks are being computed at equation 1 and 2 as seen at col. 15 lines 35 and 50 represented by S1 (i.e., a bone image signal) and S2 (i.e., a soft tissue image signal)); evaluating a first cancellation parameter against the characteristic mask (first cancellation parameter being the 'g(S1)', equation 4 at col. 17 lines 42-43 where the parameter has the effects of extracting only of the projecting part of the image signal for noise reduction in the image); computing a second cancellation parameter based on the first cancellation parameter (the noise components can be further reduced as disclosed at col. 19 lines 66-67 and explained at respective portions in the specification); and obtaining a structure cancelled image from the first and second energy level images according to a cancellation equation using one of the first and second cancellation parameter (the 'smoothed' image for both, bone and tissue, are obtained at 63, 67 and 61, 65, respectively, in Fig. 7 and at col. 21 lines 21-24, 64-66; col. 22 lines 34-37, 56-60). NOTE: the noise components being reduced in an image is the cancellation parameters as disclosed by Shimura at col. 19 lines 3-24 and the structure cancelled image obtained is the noise extraction image as seen in Fig. 6 at element 48.

With regard to **claim 6** Shimura discloses the method of claim 1, wherein the cancellation equation represents a relationship between the high energy image and the low energy image adjusted according to the first or second cancellation parameter (specifically for the bone image

S1 the noise signal SN (i.e., the cancellation equation) represents S1 and s1 which is obtained by equations 1 and 5 representing high and low energy image).

With regard to **claim 13** Shimura discloses the method of claim 1, wherein the computing the characteristic mask (as disclosed above in claim 1) step further comprises: assigning a first value to pixels representing only hard structure in the low energy level image; and assigning a second value to pixels representing only soft structure in the low energy level image (the assignments are being processed as seen at col. 15 lines 14-25 for appropriate pixels representing appropriate energy levels as the mask is being determined at equations 1-2 at col. 15 lines 35 and 50).

With regard to **claim 18** Shimura discloses the method of claim 1, further comprising: computing a hard structure cancelled image (i.e., bone image 43 in Fig. 6) and a soft structure cancelled image (i.e., soft tissue image 47 in Fig. 6) using the cancellation equation (equation 7), the first cancellation parameter and the second cancellation parameter (See, col. 17 lines 42 and col. 19 lines 12-15, 52-55, 66-67).

With regard to **claim 19** Shimura discloses the method of claim 1, wherein the second cancellation parameter is linearly related to the first cancellation parameter (note that in equations 4 and 7, the cancellation parameters are linearly related).

With regard to **claim 20** Shimura discloses the method of claim 1, wherein said step of obtaining a structure cancelled image further comprises: obtaining a first structure cancelled image from the first and second energy level images according to the cancellation equation using the first cancellation parameter; and obtaining a second structure cancelled image according to the cancellation equation using the second cancellation parameter (Shimura discloses for both

structured cancelled images an appropriate cancellation equation using an appropriate cancellation parameters for both energy levels as disclosed at col. 19 lines 3-26 and 50-67).

With regard to **claim 26,** Shimura discloses all of the claimed subject matter as already discussed above in paragraph 2 and the arguments are not repeated herein, but are incorporated by reference. Claim 26 distinguishes from claim 1 only in that it recites automatically computing a cancellation parameter having a maximum likelihood of canceling one of the first and second types of structure from a structure cancelled image. Shimura discloses canceling the bone structure image 43 when a cancellation parameter is automatically determined at 48 to superposition with the soft tissue image 47 to obtain image 46 as seen in Figure 6.

With regard to **claim 27,** Shimura discloses the method of claim 26, further comprising: computing a characteristic mask storing a first identifier at each pixel location corresponding to the first type of structure (Shimura discloses memory for storing purpose at col. 18 lines 66-67. Each pixel in the image, of type, tissue or bone, is being stored for later processing of noise reduction).

With regard to **claim 28,** Shimura discloses the method of claim 26, further comprising: determining a characteristic mask storing a pattern of pixel values defining an image outline for the first type of structure (Shimura discloses storing (i.e., in the memory as discussed in claim 27) a pattern of pixel defining image outline for a type of structure, bone and soft tissue, at col. 14 lines 60-65).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 7 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shimura in view of Sones et al. (US 4,792,900) (hereinafter, "Sones").

With regard to **claim 29,** Shimura discloses all of the claimed subject matter as already discussed above in paragraph 2 and the arguments are not repeated herein, but are incorporated by reference. Claim 29 distinguishes from claim 1 only in that it recites utilizing a pre-computed look-up table of cancellation parameters for anatomies at various high and low energy pairs. Shimura does not expressly disclose utilizing a pre-computed look-up table of cancellation parameters for anatomies at various high and low energy pairs. Sones discloses utilizing a pre-computed look-up table of cancellation parameters for anatomies at various high and low energy pairs (the first and second image are each being filtered prior to processing them for further obtaining a final results, such as, a cancelled image or generating a bone and tissue image. The look-up-table includes pixel values for each corresponding filtered function. See, col. 9 lines 26-44 and Fig. 1 elements 84, 86, 88 where the high energy and low energy images are being filtered before any other action is taken.). Shimura and Sones are combinable because they are from the same field of endeavor, i.e., dual-energy imaging. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to combine the teaching of Sones with Shimura. The motivation for doing so is to filter noisier representing regions to remove noise while substantially noise-free regions representing are not blurred or filtered to assure their diagnostic integrity and having a look-up-table with pixel values helps do just that. Therefore, it

would have been obvious to combine Sones with Shimura to obtain the invention as specified in claim 29.

With regard to **claim 7** Sones discloses the first or second cancellation parameter is being selected from a predetermined range in a look-up table, the range being determined by an effective kVp used to acquire the high level image and an effective kVp used to acquire the low level image (See, col. 9 lines 26-44).

Allowable Subject Matter

5. Claims 21-25 are allowed.

The instant invention defines a method for automatically determining a structure cancelled image in a dual energy decomposition system as disclosed in claim 21. The claimed invention distinguishes over the prior art by the manner in which the method comprising computing a gradient mask identifying a characteristic of interest from the internal structure based on a predefined cancellation parameter; localizing the characteristic of interest from the gradient mask based on a constraint parameter to form a characteristic mask; at selected pixel locations in the characteristic mask, varying the cancellation parameter over a range and obtaining for each selected pixel the cancellation parameter value yielding a desired characteristic mask value; and determining a maximum likelihood estimate of a single value for the cancellation parameter. The claimed combination allows for improving a method of automatically determining a structure cancelled image in a dual energy decomposition system. Dual energy decomposition system is conventional. However, the prior art of record fails to teach computing a gradient mask identifying a characteristic of interest from the internal

structure based on a predefined cancellation parameter; localizing the characteristic of interest from the gradient mask based on a constraint parameter to form a characteristic mask; at selected pixel locations in the characteristic mask, varying the cancellation parameter over a range and obtaining for each selected pixel the cancellation parameter value yielding a desired characteristic mask value; and determining a maximum likelihood estimate of a single value for the cancellation parameter. These elements in combination with all of the other elements of the claims are not taught or fairly suggested in the prior art of record. The dependent claims 22-25 are allowed for the same reasons.

6. Claims 2-5, 8-12, 14-17 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The closest prior art to Shimura and Sones are directed to method for automatically determining a structure cancelled image in a dual energy decomposition system as disclosed in an independent claims 1, 26 and 29. However, the closest prior art fails to disclose anything about generating a gradient mask from a ratio of the high to low energy images, at least one of the high and low energy images being adjusted based on the first or second cancellation parameter, wherein the gradient mask/image is used when automatically computing the first or second cancellation parameter as disclosed in claims 2-4. Further, the closest prior art fails to disclose step of computing a characteristic mask further comprises: convolving a Sobel operator with an image based on the low energy level and the high energy level images to form a gradient image; selecting a predetermined gradient threshold automatically from a set based upon a

selected diagnostic application; and creating the gradient mask by comparing the gradient image to the gradient threshold and assigning a first identifier to any image pixel greater than the gradient threshold and a second identifier to any image pixel less than the gradient threshold as disclosed in claim 5. The closest prior art also fails to disclose the recited equations in claims 8-9 and the localization mask in claim 10, 12. The closest prior are further fails to disclose the evaluating step further comprises: generating a series of gradient maps utilizing the cancellation equation and high and low energy level images by adjusting the first cancellation parameter to a value having a maximum likelihood of emphasizing the first type of structure as disclosed in claim 14 and the evaluating step further comprises: computing multiple gradient maps using a range of cancellation parameters from a look up table; and determining a lowest gradient value for each pixel location by comparing corresponding pixel locations of the multiple gradient maps to each other and identifying an associated cancellation parameter for each of the identified lowest gradient values as recited in claim 15.

It is for these reasons in combination with all the other elements of the claim that claims 2-5, 8-10, 12, and 14-15 are would be allowable if rewritten in independent form including all of the limitation of the base claim and any intervening claims. Claims 11 and 16-17 are allowable for the same reason as claims 2-5, 8-10, 12, and 14-15.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. US 6,597,759; US 6,343,111; US 5,402,338; US 6,205,348; US 4,499,493; US 4,355,331; US 6,173,034; US 5,838,758.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shefali D Patel whose telephone number is 703-306-4182. The examiner can normally be reached on M-F 8:00am - 5:00pm (First Friday Off).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Leo H Boudreau can be reached on 703-305-4706. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DANIEL MANUM
PRIMARY EXAMINER

May 13, 2004

Shefali D Patel
Examiner
Art Unit 2621